

**WHAT IS CLAIMED IS:**

1. A method for applying a metallurgical coating to a superalloy substrate comprising the steps of:

5 a) directing a water jet having a sufficient pressure against the surface of the superalloy substrate for a sufficient time period to modify the surface morphology of the substrate in a such a manner so that the surface roughness and surface volume of the substrate are increased at a microscopic and macroscopic level; and

b) depositing a metallurgical coating on the modified surface of the substrate by high velocity oxygen fuel spray.

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2. A method according to Claim 1, including depositing a metallurgical coating layer having a thickness ranging to and in excess of .500 inches.

15 3. A method according to Claim 1, further comprising the step of grit blasting the surface of the substrate to increase surface roughness prior to treating the surface with a water jet.

4. A method according to Claim 1, further comprising the step of heat treating the coated substrate.

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5. A method according to Claim 4, wherein the step of heat treating includes heat treating the coated substrate under vacuum.

6. A method according to Claim 5, further comprising the step of subjecting the coated substrate to hot isostatic pressing.

5 7. A method according to Claim 1, wherein the step of directing a water jet at the surface of the substrate includes directing a water jet at the surface at a pressure of about 55,000 psi.

8. A method according to Claim 1, wherein the step of depositing a  
10 metallurgical coating on the surface of the substrate includes depositing a platinum aluminide metallurgical coating onto the surface of the substrate.

9. A method according to Claim 1, wherein the step of depositing a metallurgical coating on the surface of the substrate includes depositing a MCrAlY  
15 metallurgical coating onto the surface of the substrate, wherein M is selected from the group consisting of Co, Ni and NiCo.

10. A method for applying a metallurgical coating to a superalloy substrate comprising the steps of:

20 a) roughening the surface of the superalloy substrate through grit blasting;

b) directing a water jet having a sufficient pressure against the roughened surface of the substrate for a sufficient time period to modify the surface morphology of the substrate; and

c) depositing a metallurgical coating on the modified surface of the substrate by high velocity oxygen fuel spray.

11. A method according to Claim 10, further comprising the step of vacuum heat treating the coated substrate.

12. A method according to Claim 11, further comprising the step of subjecting the coated substrate to hot isostatic pressing.

13. A method according to Claim 10, wherein the step of depositing a metallurgical coating on the surface of the substrate includes depositing a platinum aluminide metallurgical coating onto the surface of the substrate.

14. A method according to Claim 10, wherein the step of depositing a metallurgical coating on the surface of the substrate includes depositing a MCrAlY metallurgical coating onto the surface of the substrate, wherein M is selected from the group consisting of Co, Ni and NiCo.

15. A method for applying a two-layer metallurgical coating system to a superalloy substrate comprising the steps of:

- a) directing a water jet having a sufficient pressure against the surface of the superalloy substrate for a sufficient time period to modify the surface morphology of the substrate;
- b) depositing a first metallurgical coating layer onto the modified surface of the substrate by high velocity oxygen fuel spray;
- c) directing a water jet having a sufficient pressure against the surface of the first metallurgical coating layer for a sufficient time period to modify the surface morphology of the first metallic coating layer; and
- d) depositing a second coating layer onto the modified surface of the first metallurgical coating layer.

16. A method according to Claim 15, further comprising the step of grit blasting the surface of the substrate to increase surface roughness prior to treating the surface of the substrate with a water jet.

17. A method according to Claim 15, wherein the step of depositing a second coating layer onto the modified surface of the first metallurgical coating layer includes deposition of a second metallurgical coating layer onto the modified surface of the first metallurgical coating layer by high velocity oxygen fuel spray.

18. A method according to Claim 15, wherein the step of depositing a second coating layer onto the modified surface of the first metallurgical coating layer includes deposition of a ceramic coating layer onto the modified surface of the first metallurgical coating layer by plasma thermal spray.

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19. A method according to Claim 18, wherein the step of depositing a second coating layer includes deposition of a 6-8 weight % Yttria stabilized zirconium oxide ceramic thermal barrier coating over the modified surface the first metallurgical coating layer.

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20. A method according to Claim 17, wherein the deposition of at least one of the first and second metallurgical coating layers includes the step of depositing a platinum aluminide metallurgical coating.

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21. A method according to Claim 17, wherein the deposition of at least one of the first and second metallurgical coating layers includes the step of depositing a MCrAlY metallurgical coating, wherein M is selected from the group consisting of Co, Ni and NiCo.

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22. A method according to Claim 15, further comprising the step of vacuum heat treating the coated substrate prior to deposition of the second coating layer.

23. A method according to Claim 22, further comprising the step of subjecting the coated substrate to hot isostatic pressing prior to deposition of the second coating layer.

24. A method for applying a three-layer metallurgical coating system to a  
5 superalloy substrate comprising the steps of:
- a) directing a water jet having a sufficient pressure against the surface of the superalloy substrate for a sufficient time period to modify the surface morphology of the substrate; and
  - b) depositing a first metallurgical coating layer onto the modified  
10 surface of the substrate by high velocity oxygen fuel spray;
  - c) directing a water jet having a sufficient pressure against the surface of the first metallurgical coating layer for a sufficient time period to modify the surface morphology of the first metallurgical coating layer;
  - d) depositing a second metallurgical coating layer onto the modified  
15 surface of the first metallurgical coating layer by high velocity oxygen fuel spray;
  - e) directing a water jet having a sufficient pressure against the surface of the second metallurgical coating layer for a sufficient time period to modify the surface morphology of the second coating layer; and
  - f) depositing a third coating layer onto the modified surface of the  
20 second metallurgical coating layer.

25. A method according to Claim 24, further comprising the step of grit blasting the surface of the substrate to increase surface roughness prior to treating the surface of the substrate with a water jet.
- 5 26. A method according to Claim 24, wherein the step of depositing a third coating layer onto the modified surface of the second metallurgical coating layer includes deposition of a ceramic coating layer onto the modified surface of the second metallurgical coating layer by plasma thermal spray.
- 10 27. A method according to Claim 26, wherein the step of depositing a third coating layer includes deposition of a 6-8 weight % Ytria stabilized zirconium oxide ceramic thermal barrier coating over the modified surface the second metallurgical coating layer.
- 15 28. A method according to Claim 24, wherein the deposition of at least one of the first and second metallurgical coating layers includes the step of depositing a platinum aluminide metallurgical coating.
- 20 29. A method according to Claim 24, wherein the deposition of at least one of the first and second metallurgical coating layers includes the step of depositing a MCrAlY metallurgical coating, wherein M is selected from the group consisting of Co, Ni and NiCo.

30. A method according to Claim 24, further comprising the step of vacuum heat treating the coated substrate prior to deposition of the second coating layer.

31. A method according to Claim 30, further comprising the step of subjecting the coated substrate to hot isostatic pressing prior to deposition of the second coating layer.

32. A gas turbine component made by a process comprising the steps of:

- a) providing a gas turbine component defining a superalloy substrate;
- b) directing a water jet having a sufficient pressure against the surface of the superalloy substrate for a sufficient time period to modify the surface morphology of the substrate; and
- c) depositing a metallurgical coating layer onto the modified surface of the substrate by high velocity oxygen fuel spray.

33. A gas turbine component made by a process comprising the steps of:

- a) providing a gas turbine component defining a superalloy substrate;
- b) roughening the surface of the substrate through grit blasting;
- c) directing a water jet having a sufficient pressure against the roughened surface of the substrate for a sufficient time period to modify the surface morphology of the substrate; and
- d) depositing a metallurgical coating on the modified surface of the substrate by high velocity oxygen fuel spray.